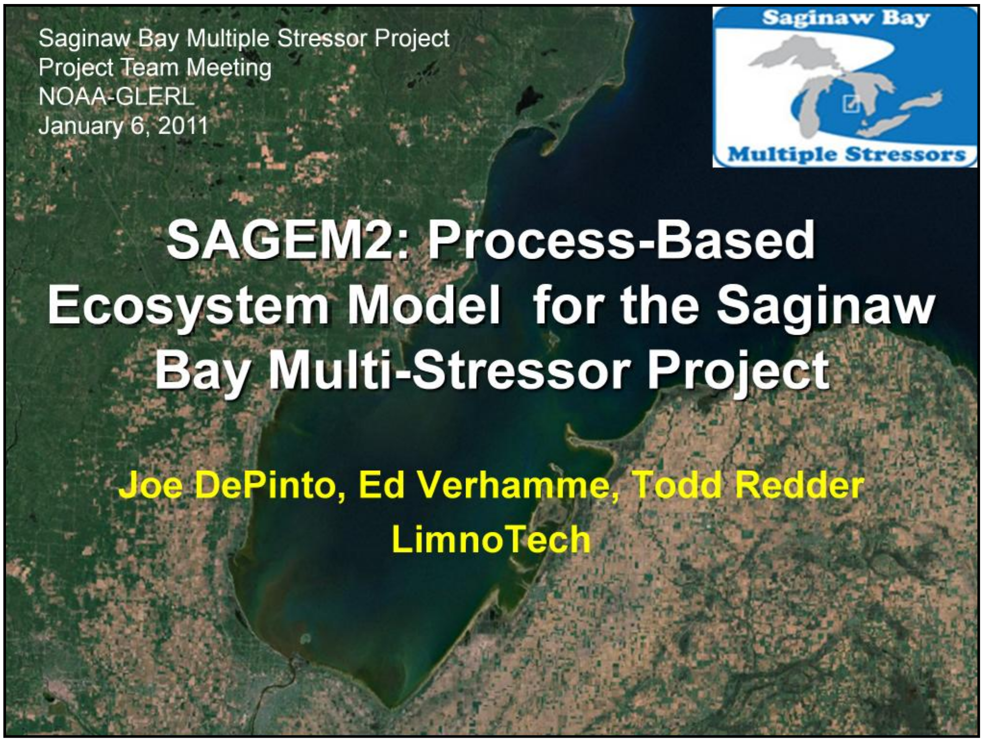
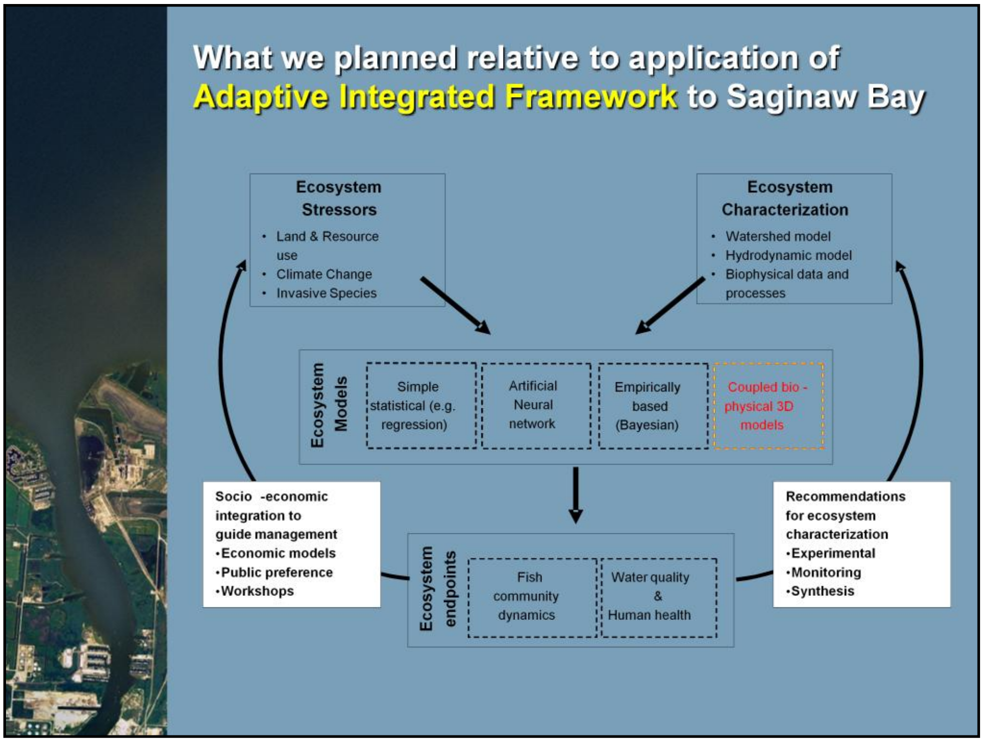
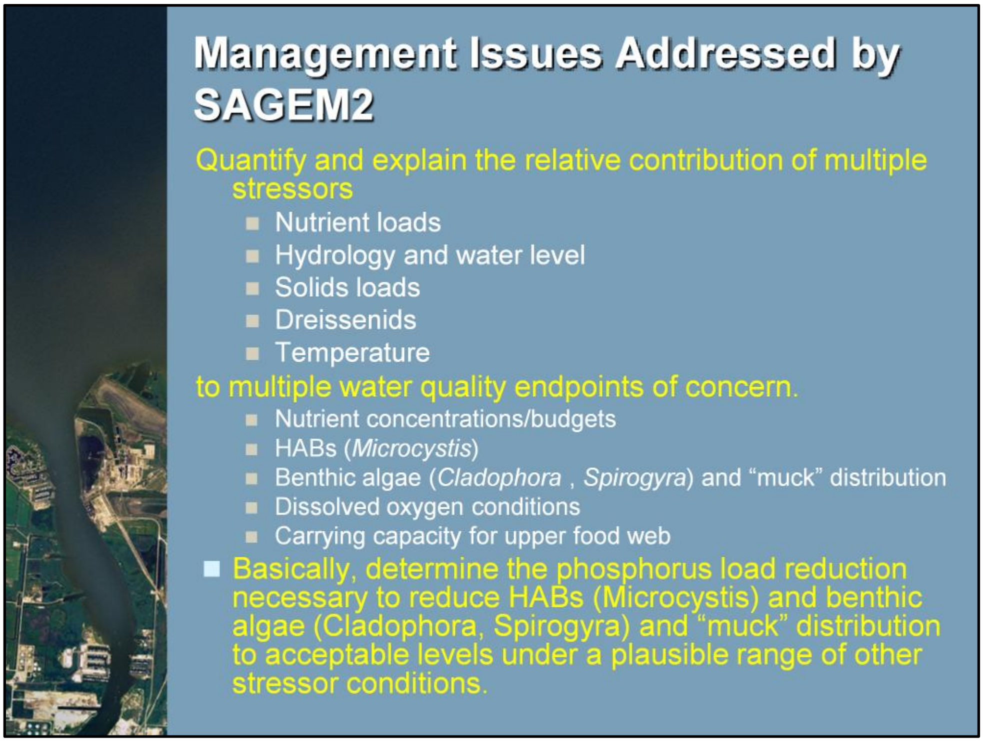


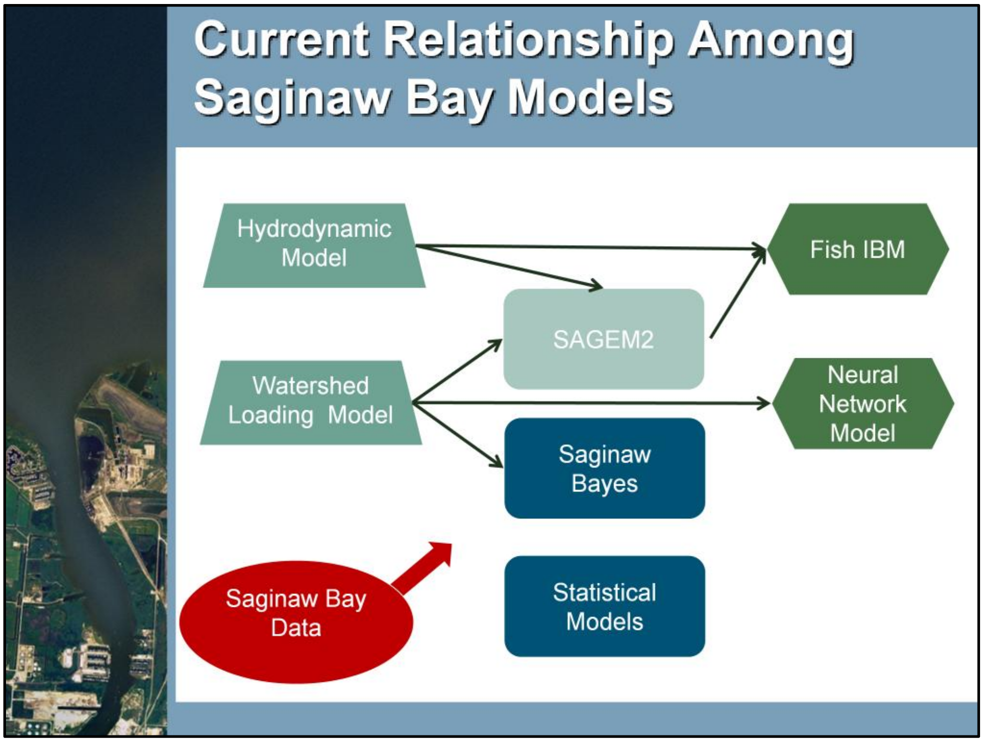
Craig asked us to present: what we planned, what we have accomplished, and our plan for the remainder of project.



Four categories of models are being developed in this study. Range of complexity and potential utility. Comparison of these models provides great value for both understanding and management support. Our role in this project is to build a linked, process-based, deterministic hydrodynamic – lower food web model for Saginaw Bay – the most complex of the model frameworks being developed.

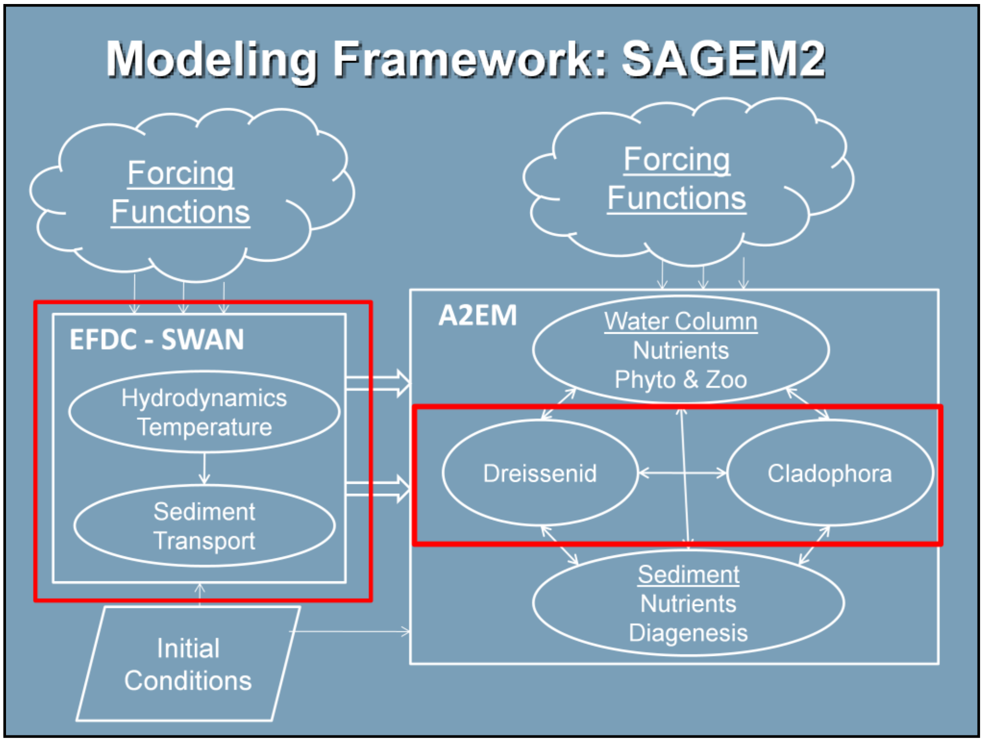


Since only water quality management option is to control nutrient loads, we will focus on response to phosphorus loads. Also, managers have expressed a number if times the desire to answer the question of whether current target phosphorus loading needs to be adjusted to address the current problems in the bay.

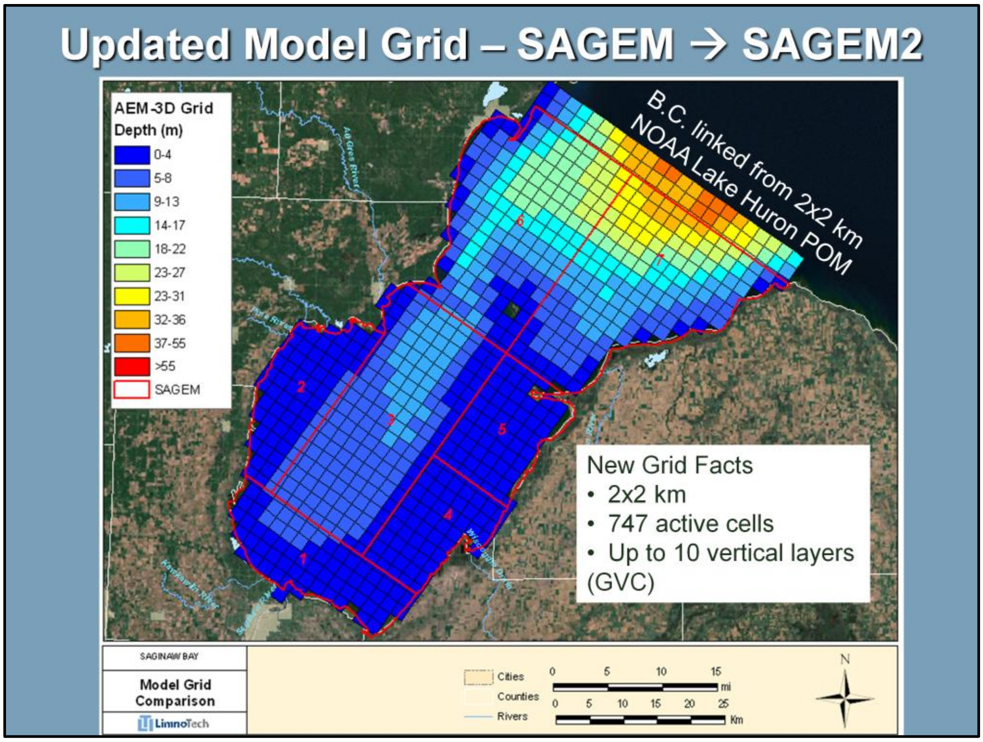


The management questions have guided model conceptual development necessary to address those questions in a quantitative way. Here is a picture of the various models being developed in this project and their relationship to each other. The models require data and are first used to identify data and knowledge gaps to help direct research and monitoring.

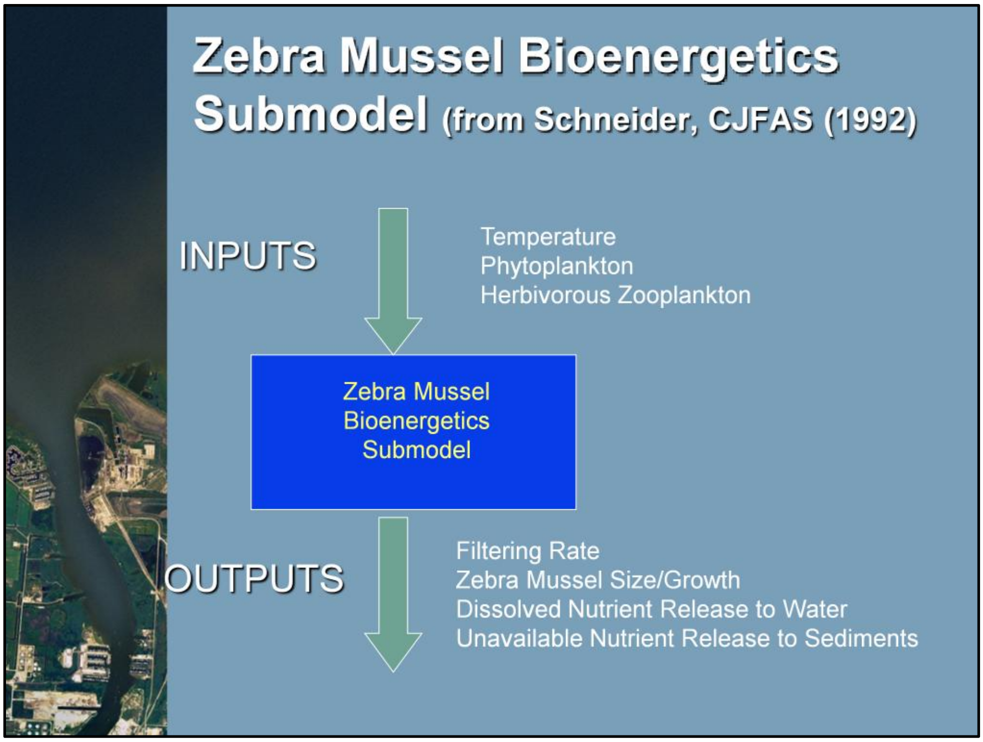
First step was to build the Saginaw Bay ecosystem model – started from previous Saginaw Bay ecosystem model.



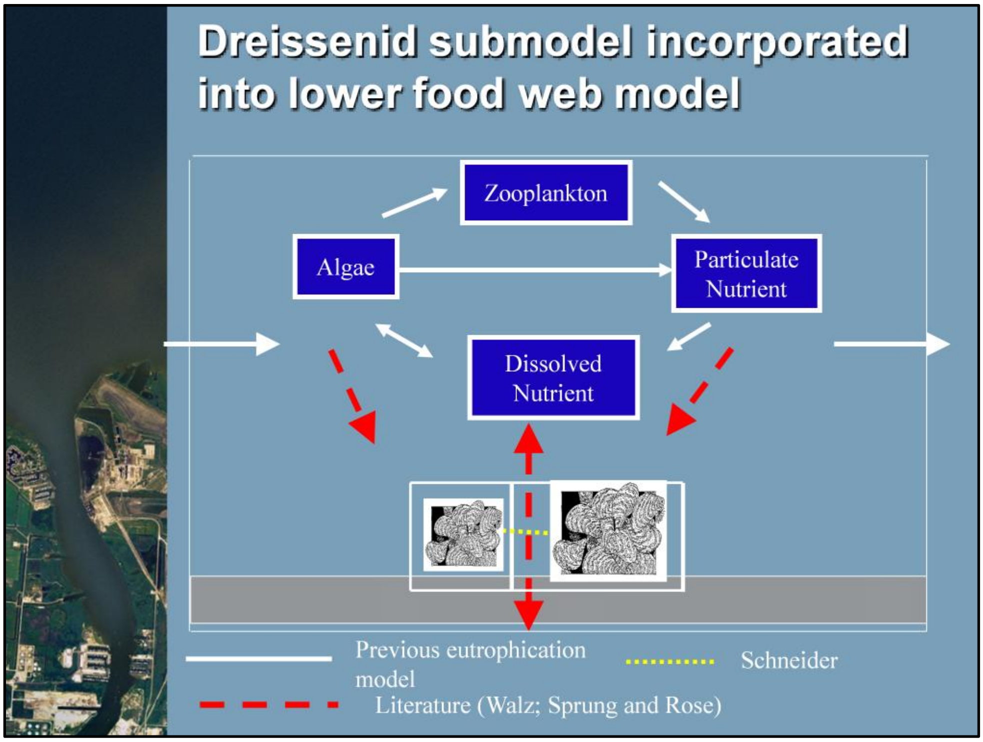
Linked EFDC-A2EM model – added dreissenid submodel from SAGEM (can model 3 cohorts of both zebra mussels and quagga mussels) and Auer's GLCM.



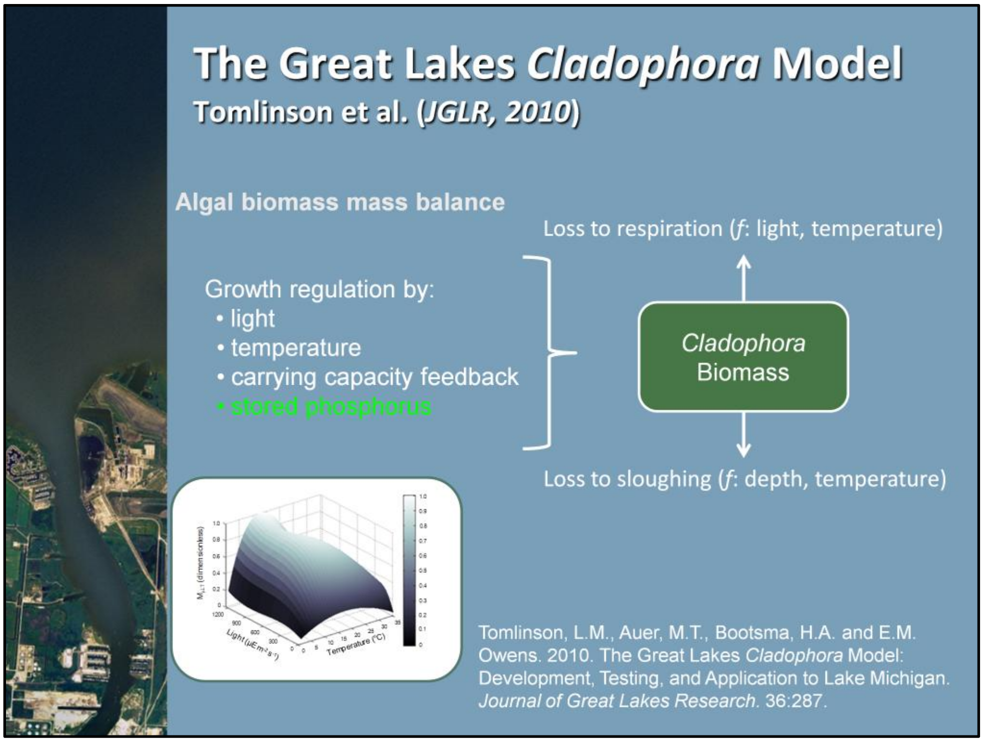
SAGEM2 has much finer grid than SAGEM – to capture important circulation and transport patterns in bay. GLERL whole lake POM model provides boundary conditions for exchange with main lake.



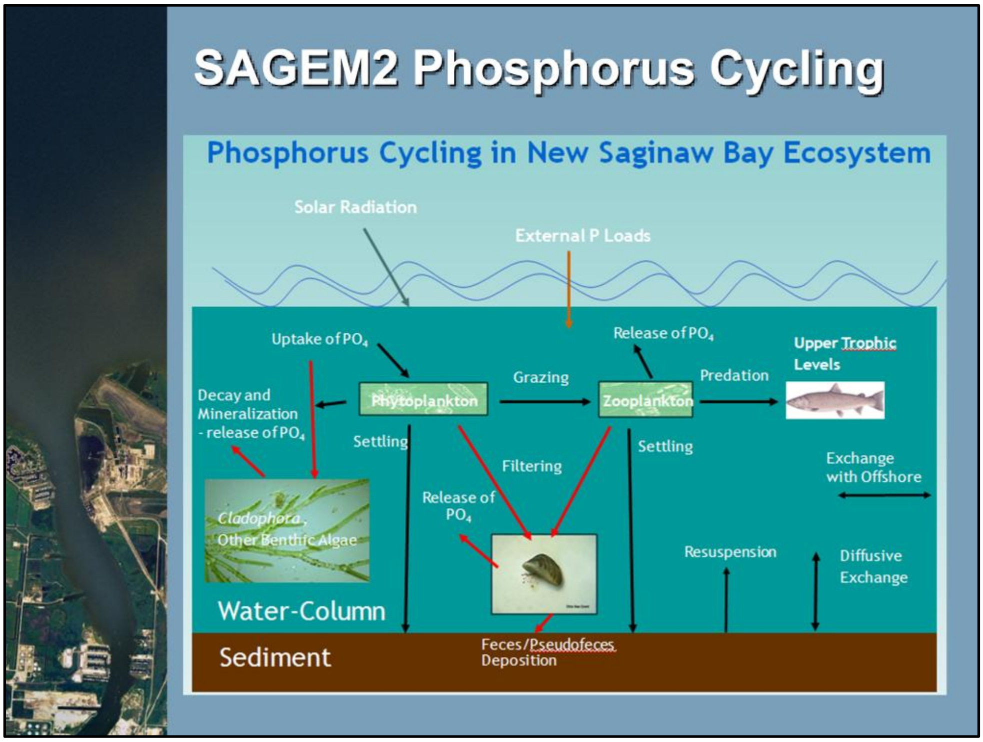
Dreissenid bioenergetics model developed from work of Schneider. We do not model Dreissenid population dynamics, just start with initial densities and grow mussels through the growing season.



Dreissenids have been incorporated into SAGEM2 to account for the way they modify plankton, particulate detritus, and nutrient dynamics.



Cladophora submodel is taken from Auer's recent modeling work and also incorporated into plankton and nutrient dynamics of full SAGEM2.

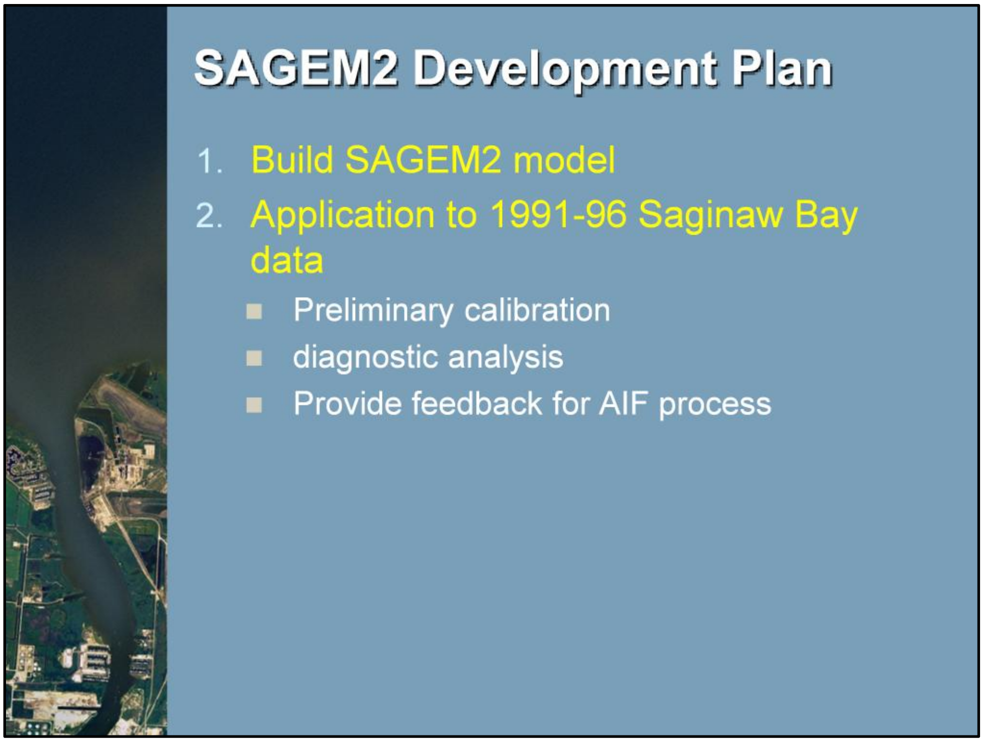


This slide shows how Dreissenids and Cladophora affect the other phosphorus cycling in SAGEM2.

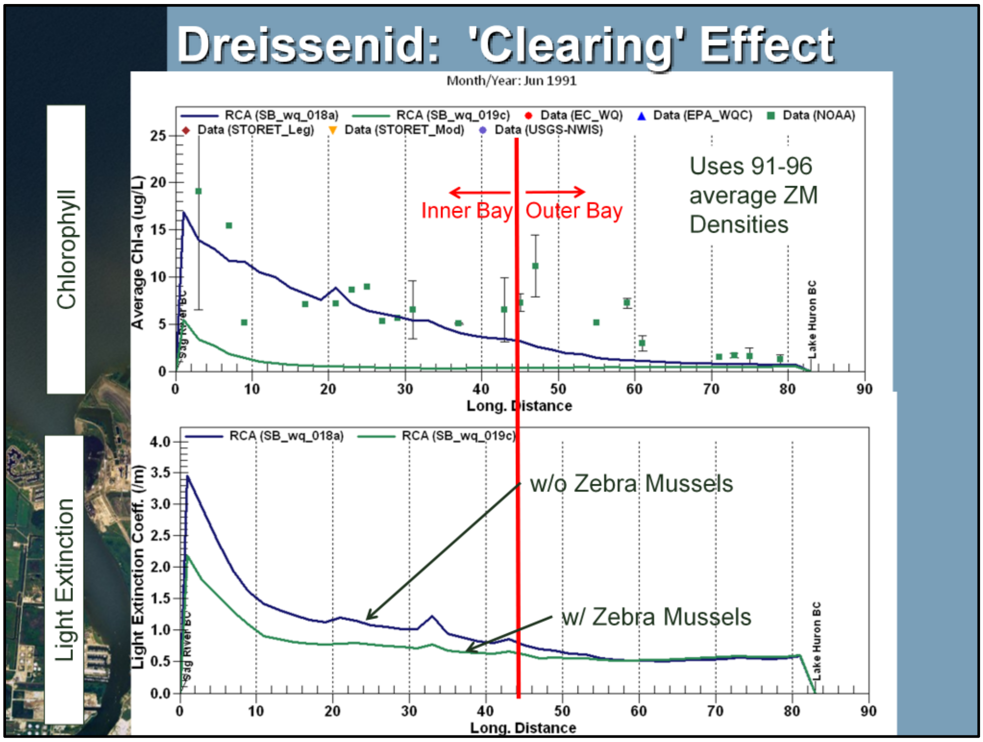
SAGEM versus SAGEM2

Category	SAGEM	SAGEM2
Hydrodynamic model	2D chloride mass balance 7 segments	3D model 2Km grid with 747 cells Up to 10 vertical layers
Sediment Transport – Resuspension	Calibrated empirical relationship with wind	Coupled SWAN (wind-wave model) with EFDC
Water Quality Model	Customized framework built from Bierman model	Documented and highly tested framework. Full sediment diagenesis sub-model
Benthic Algae Sub-model	Simple kinetics, attached green alga not specific to Cladophora	Auer Cladophora model (GLCM) with tracking of sloughed biomass
Filter Feeder Sub-model	1 species with 3 cohorts	2 species with 3 cohorts Complete mass balance

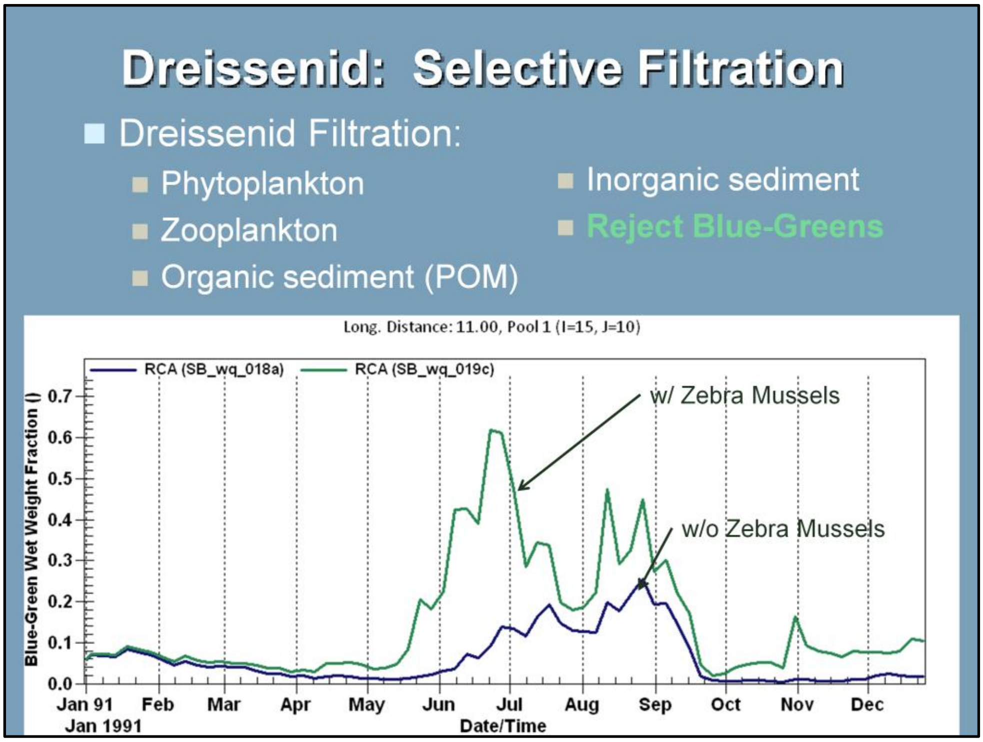
Summary of major refinements in SAGEM2 relative to SAGEM.



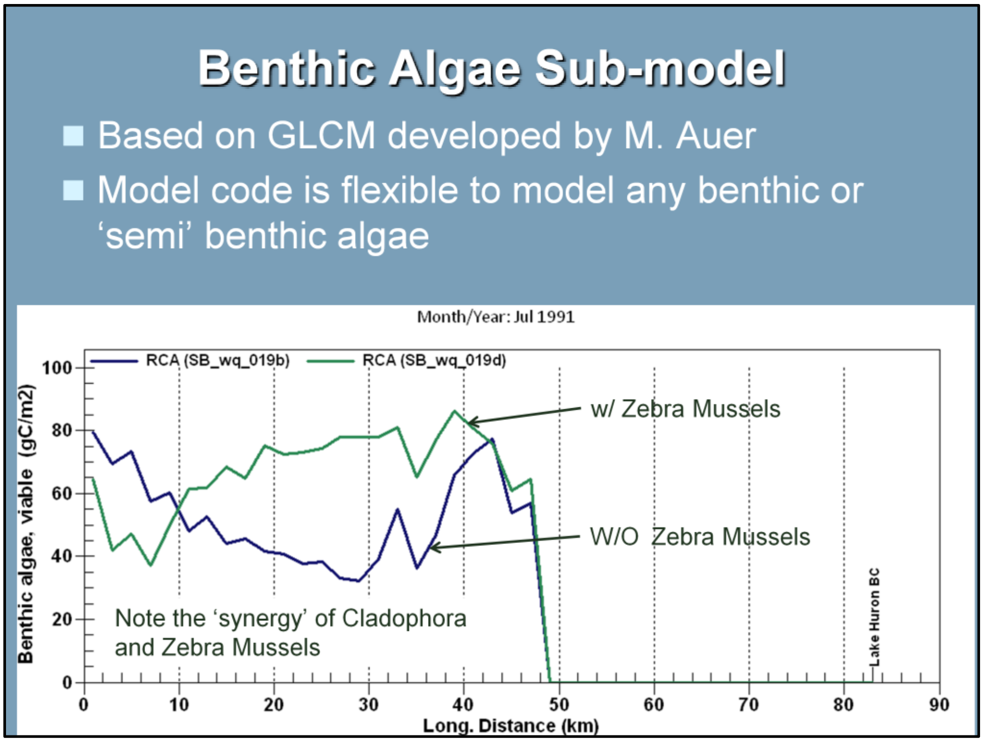
Finished first two bullets



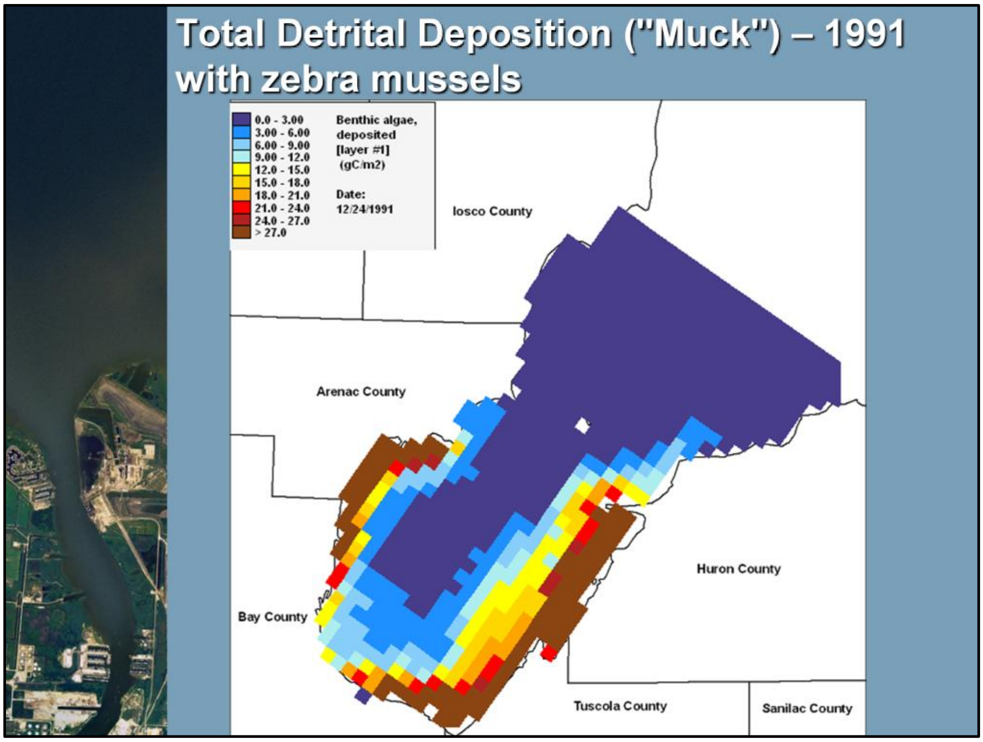
Example of the effect on chlorophyll and light extinction coefficient of including zebra mussels (at 1991-96 average densities) in SAGEM2 as applied to 1991.



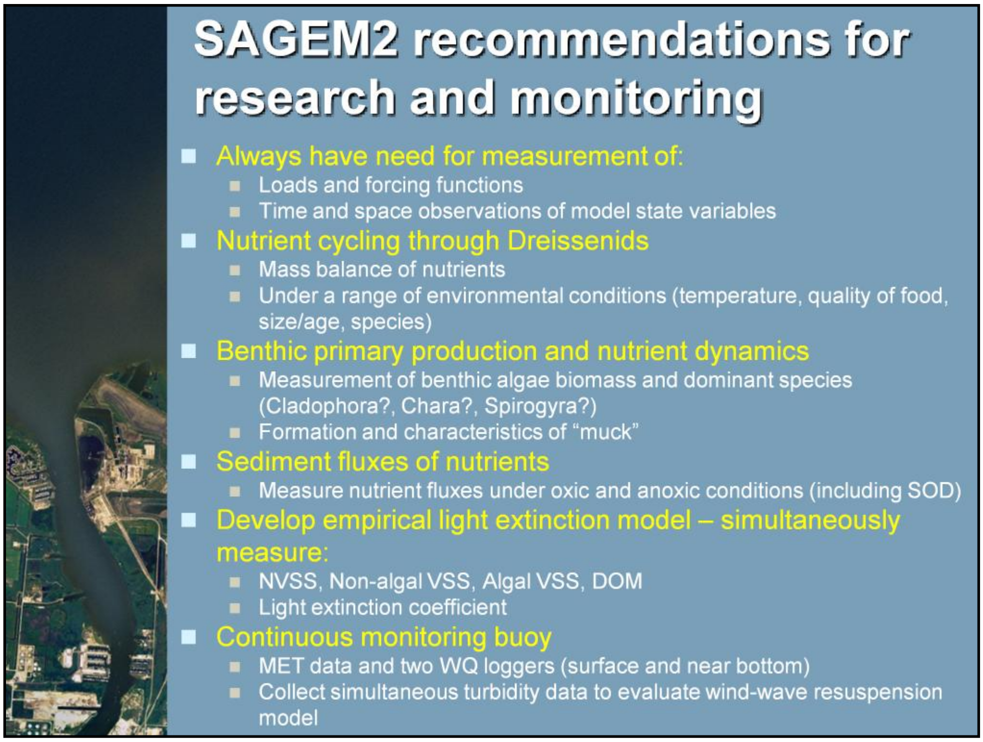
Altered sediment phosphorus recycle by dreissenids (late summer P release from sediments) and selective rejection of blue-greens are both necessary and sufficient to cause increase of Microcystis blooms in bay.



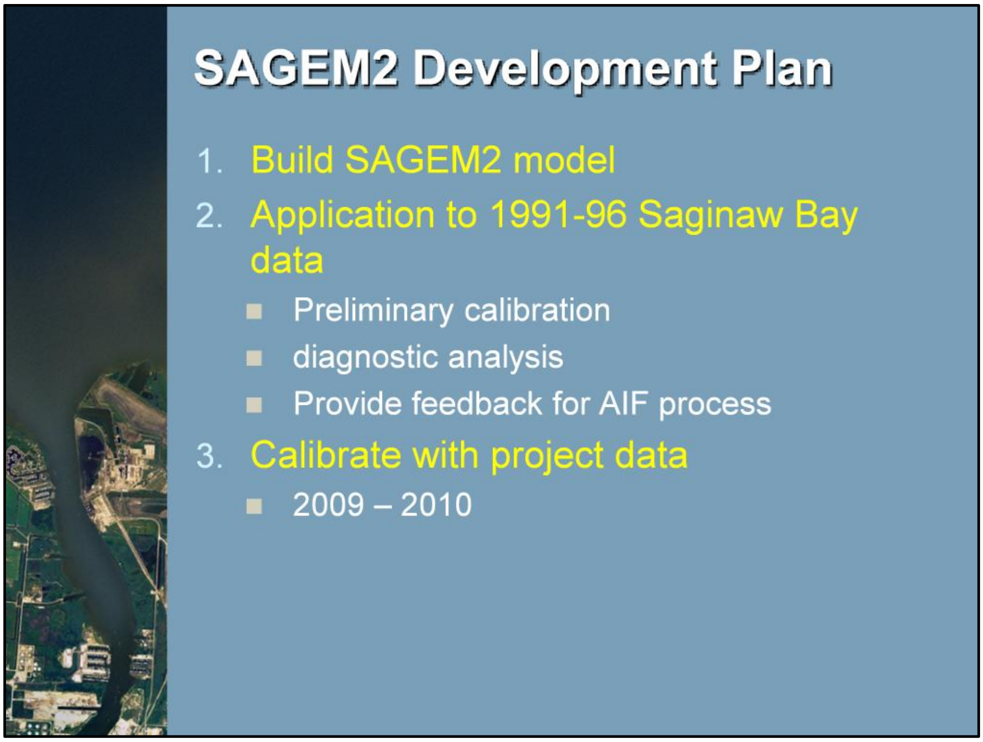
Cladophora growth is enhanced by filtering action of Dreissenids – increased water clarity and increased phosphorus availability.



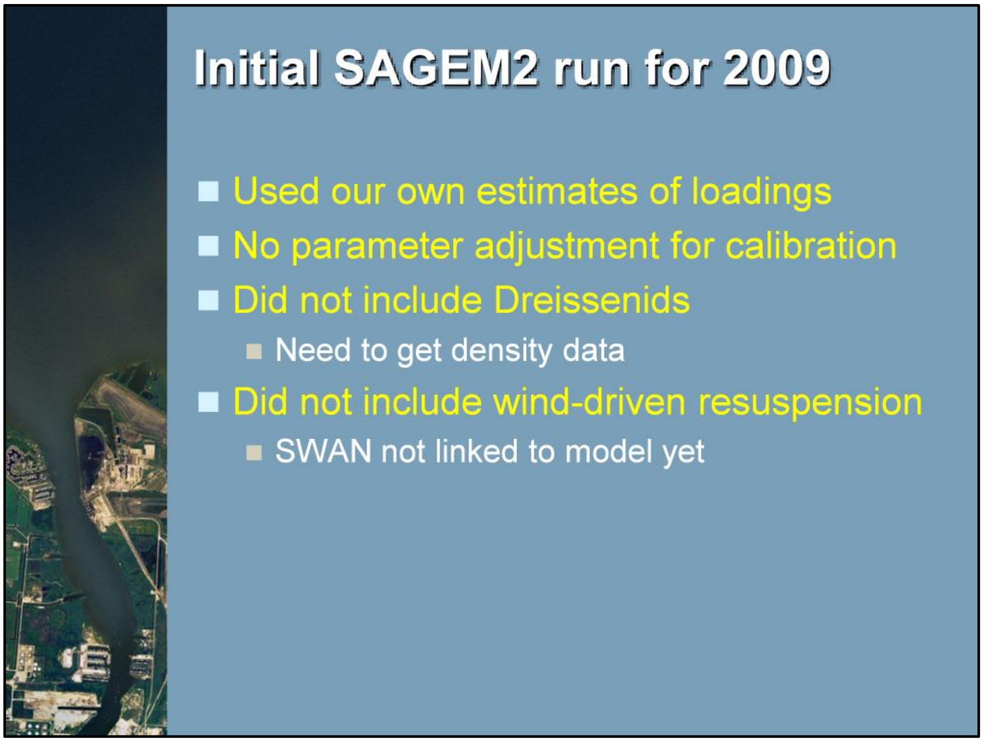
New state variable for detrital benthic algae has been added to the model to track transport of “muck” precursor material.



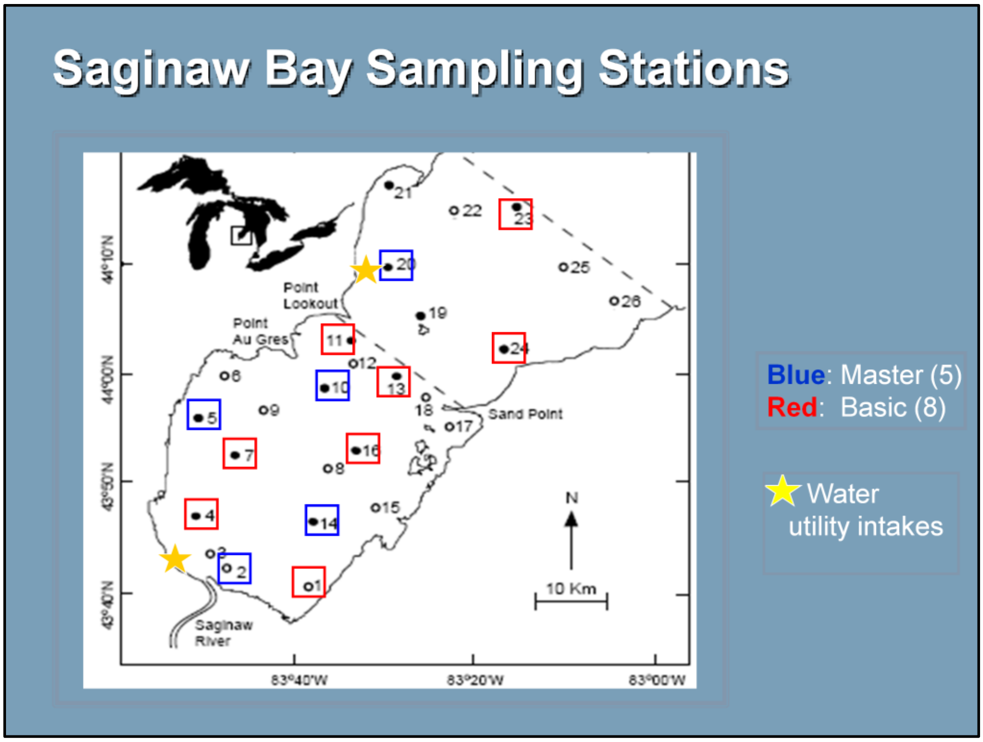
This slide gives an overview of the feedback and recommendations to the field and process researchers from our initial SAGEM2 modeling as to the process experimentation and field work that can have great value in reducing model prediction uncertainty by providing process rate coefficients for the model that have been seen to produce uncertainty as well as sensitivity in model output. Most of these recommendations have been addressed by project researchers.



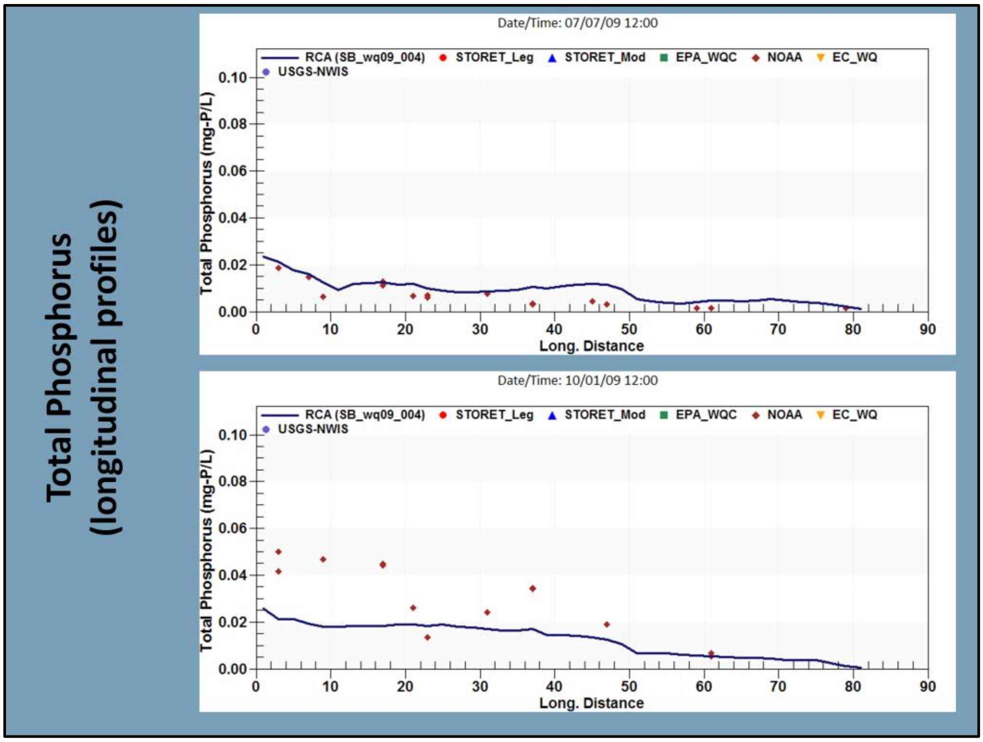
We have a preliminary run for 2009 using coefficients from the ‘91-’96 application work, except…next slide.



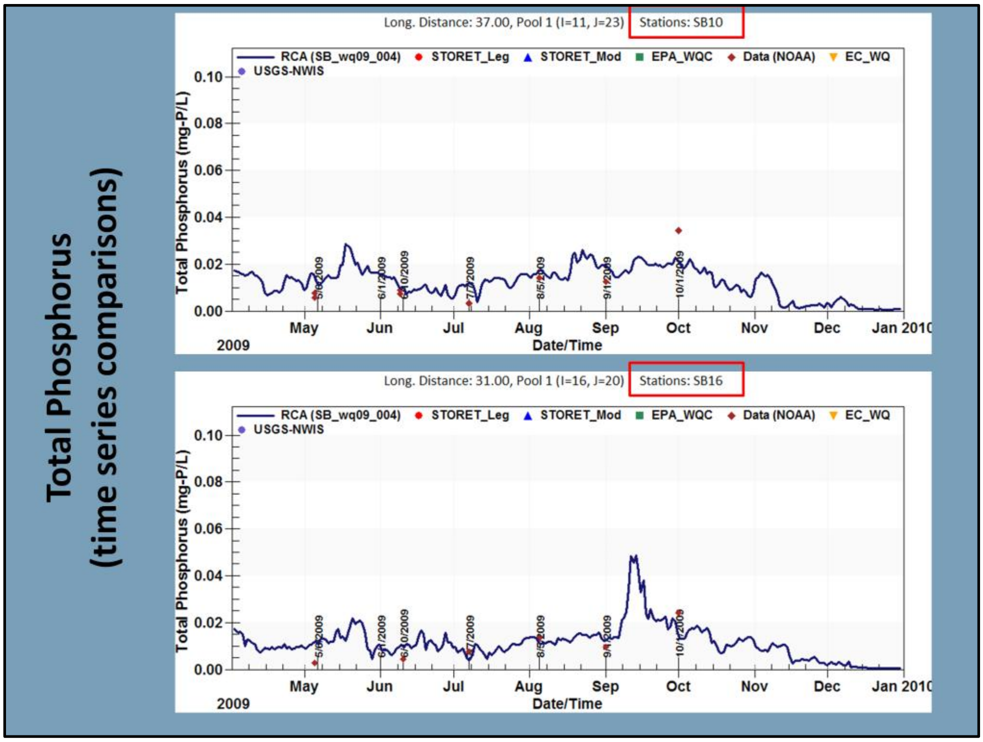
The results presented below for our 2009 preliminary run have the following caveats and should not be considered final.



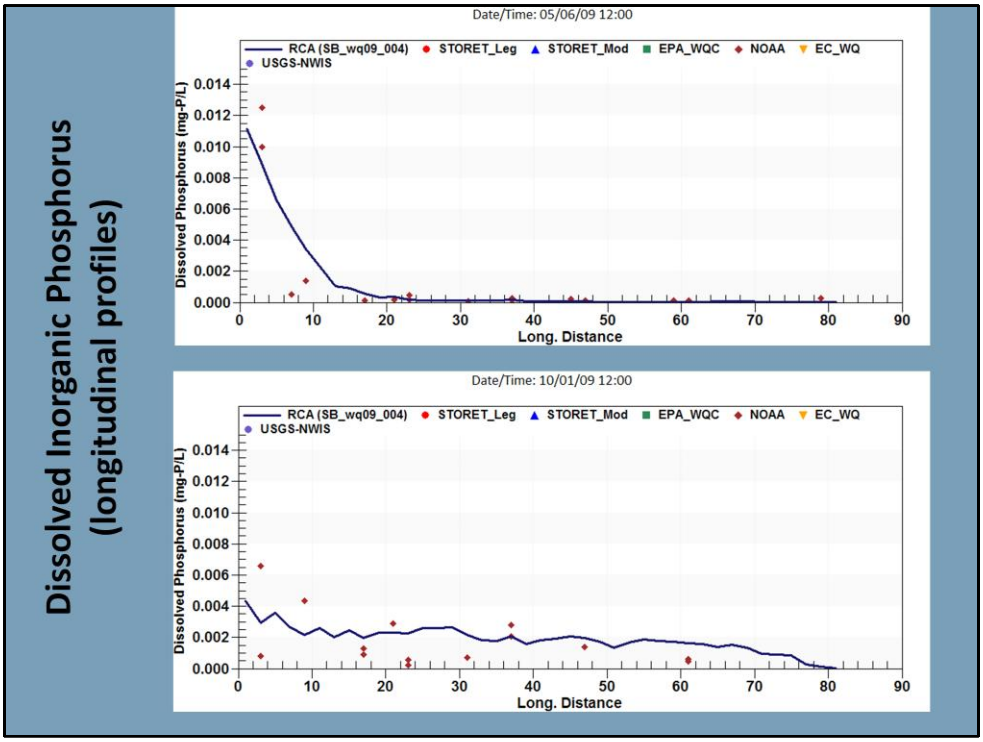
Calibration will make use of bay water quality sampling data.



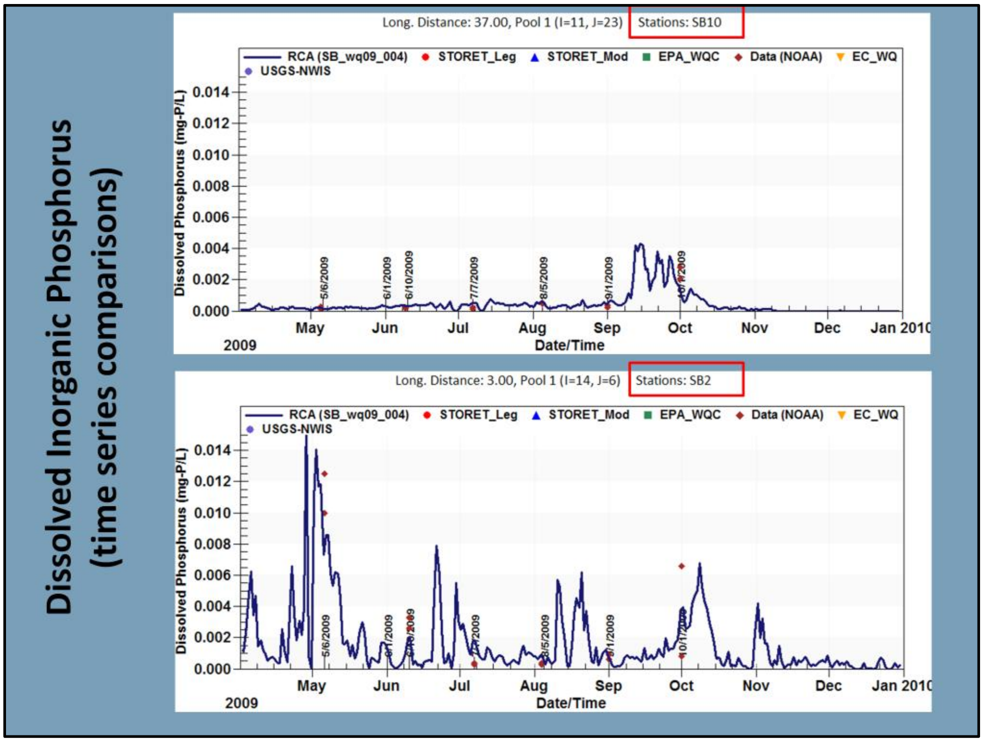
TP longitudinal profiles (laterally averaged) on two days in 2009. Wind-driven resuspension not included in run – wind event in early October not captured by model.



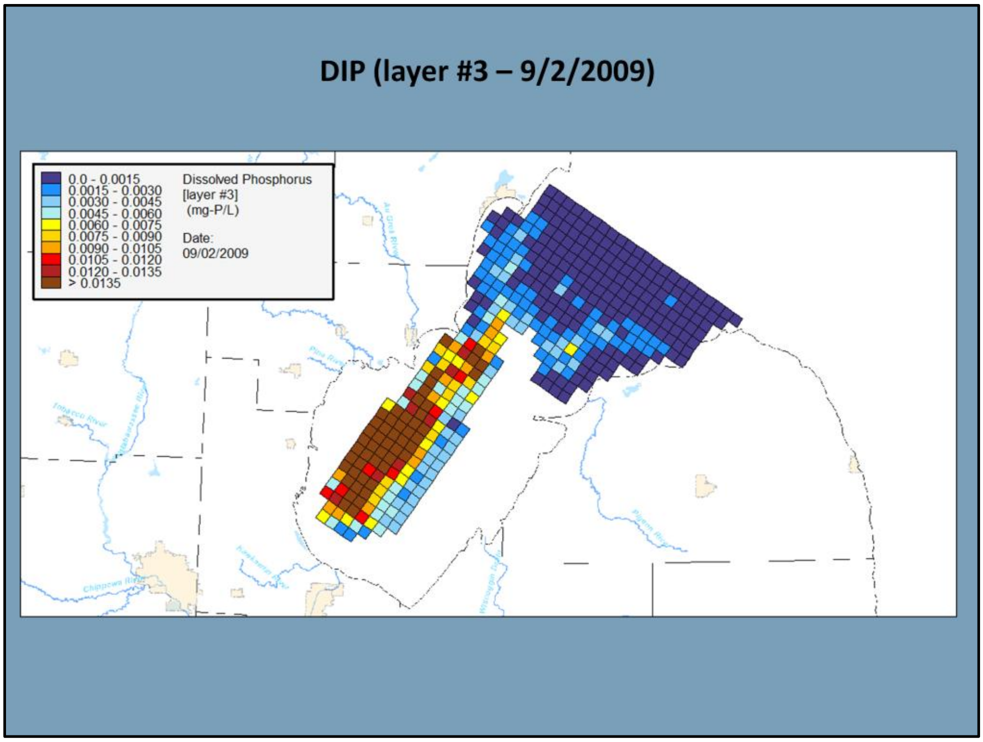
Time series TP comparisons with data at two stations.



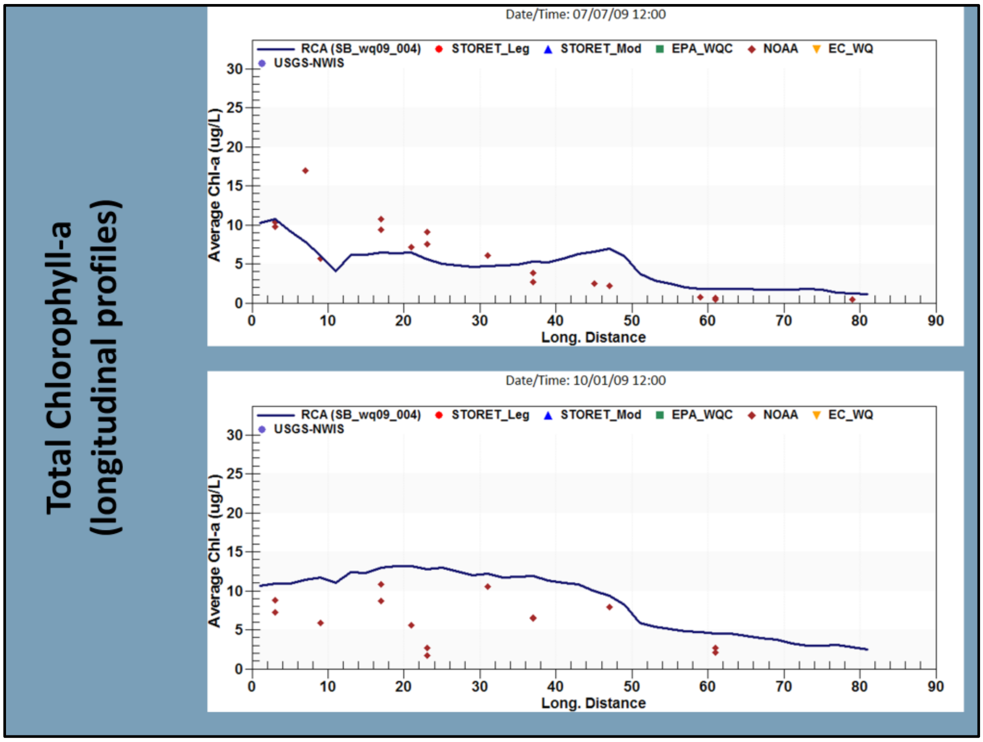
Dissolved inorganic P longitudinal profiles (laterally averaged) on two days in 2009. May simulation day is during a high Saginaw River load.



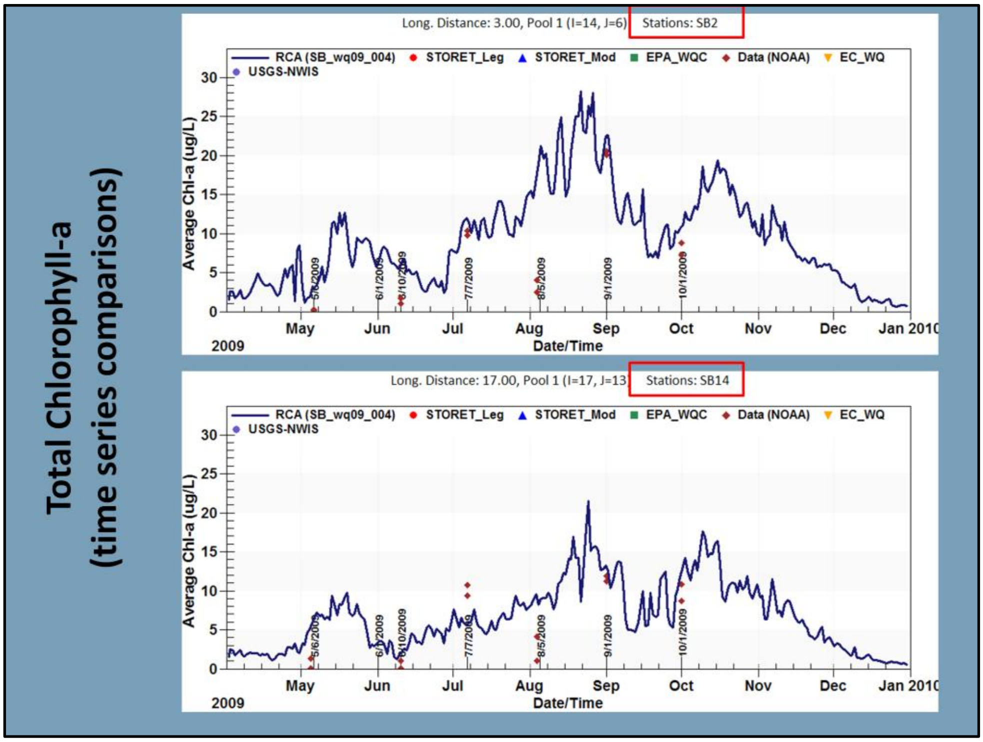
Time series DIP comparisons with data at two stations.



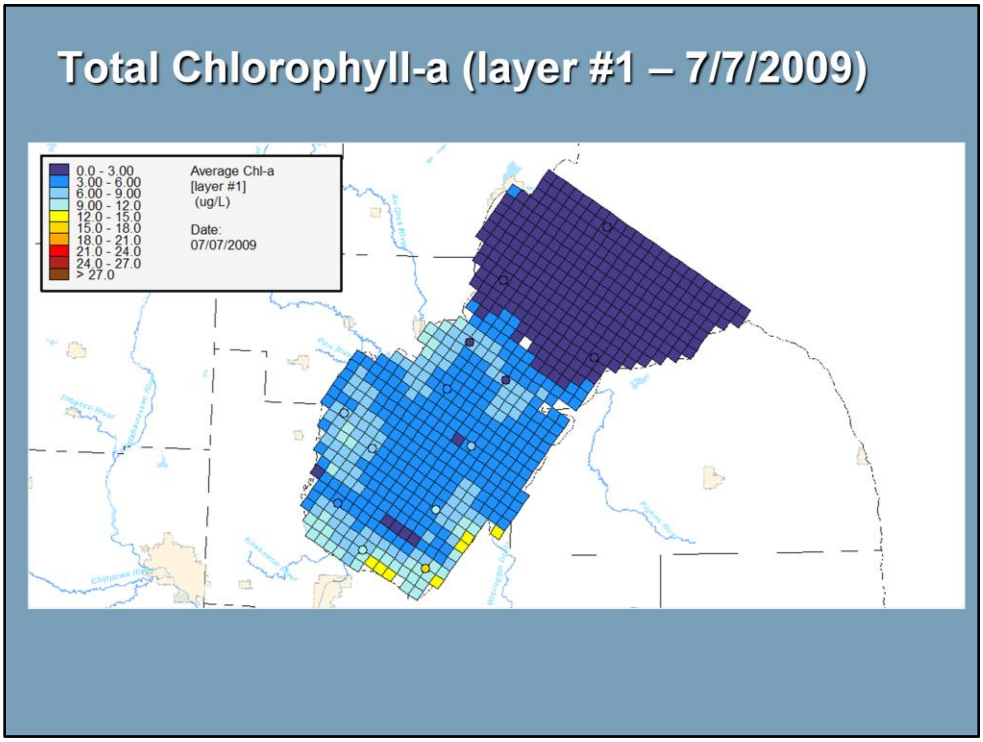
Model is computing sediment P release from deeper, more organic sediments in inner bay.



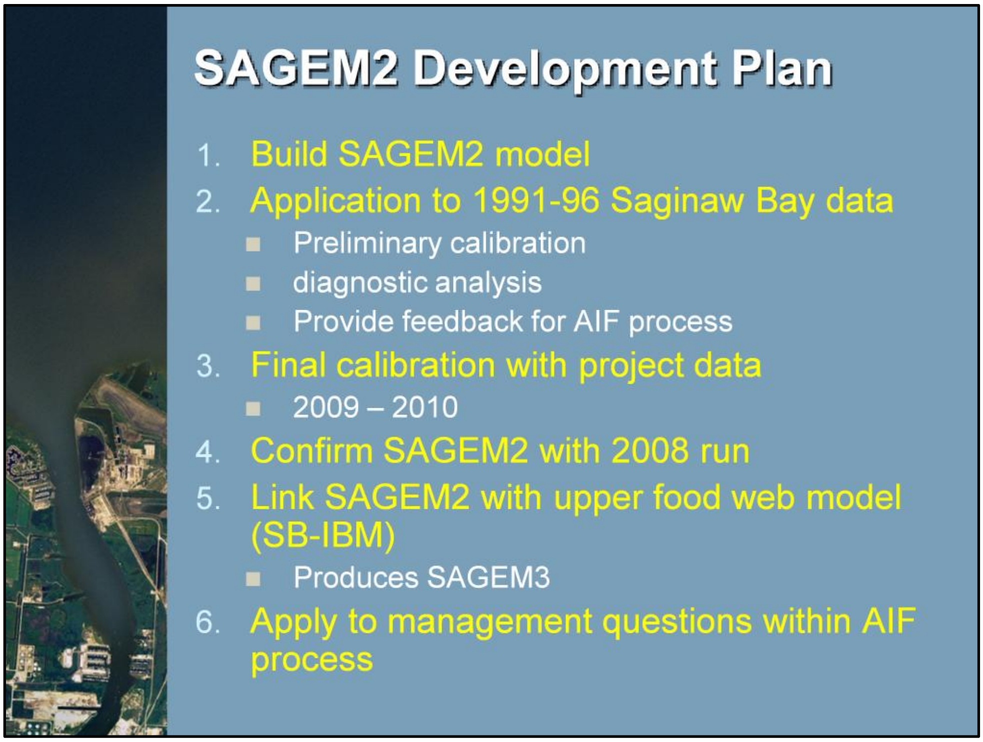
Chlorophyll-a longitudinal profiles (laterally averaged) on two days in 2009. Over-prediction in October may be related to inadequate light growth limitation from inadequate sediment resuspension.



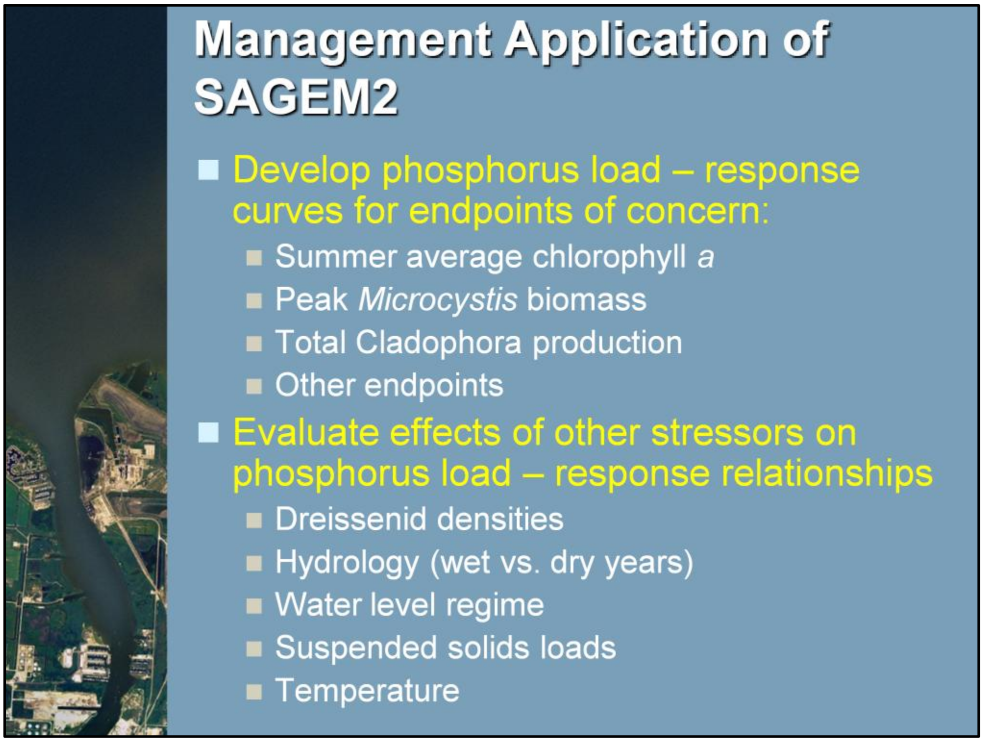
Slight over-prediction of chlorophyll in fall.



Model post-processor can also compare 2D map of simulation on a given day with the observations on that day.



Remainder of steps for SAGEM2 development and application in this project.



Need to work with managers and other project team members to develop specific scenarios to run with model.

Need to work with managers and other project team members to develop specific scenarios to run with model.

1.5 more years for this project – remaining time will be spent modeling and analyzing data and using this to provide advice to managers. However, we will likely produce additional questions and data needs that might be undertaken in 2012 in Saginaw Bay.